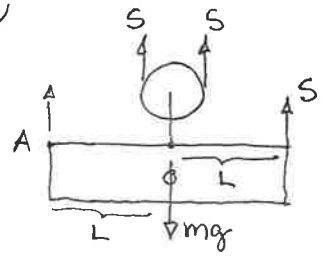
Lösningar Mekanik för V & Bi 3/6-15 \P-EA

1)



Moment kring A:

$\curvearrowleft_A \quad 2S\cdot L + S\cdot 2L - mgL = 0$;

$4S = mg$; $S = \frac{mg}{4} = 147\,N$ ⇒

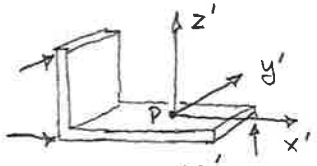
---

2)

Kraftresult.: $\underset{\sim}{R} = (20, 40, 40) = 60\left(\frac{1}{3}, \frac{2}{3}, \frac{2}{3}\right)$

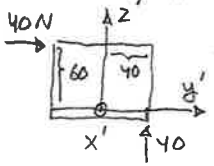
Belopp $R = \sqrt{20^2+40^2+40^2} = 60\,N$ ⇒ (enhets-vektor)

Moment map P:



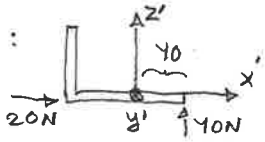
Komponenterna tas fram genom projektioner

M_x^P:



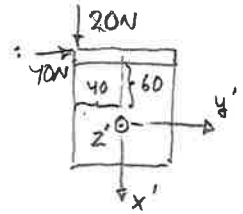
$M_x^P = -40\cdot 60 + 40\cdot 40 = -800\,N\,mm$

M_y^P:



$M_y^P = -40\cdot 40 = -1600\,N\,mm$

M_z^P:



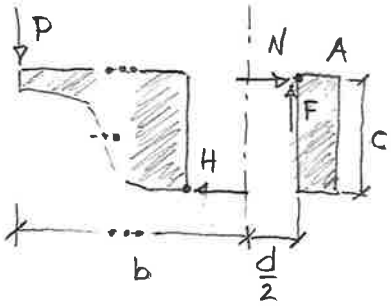
$M_z^P = 20\cdot 40 - 40\cdot 60 = -1600\,N\,mm$

⇒ $\underset{\sim}{M} = (-0.8, -1.6, -1.6)\,Nm = -2.4\left(\frac{1}{3}, \frac{2}{3}, \frac{2}{3}\right)$

$M = \sqrt{0.8^2+1.6^2+1.6^2} = 2.4\,Nm$ ⇒ samma som för $\underset{\sim}{R}$ //

150603 forts

3)



$(\rightarrow) \quad N - H = 0$; $H = N$

$(\uparrow) \quad F - P = 0$; $F = P$

$\curvearrowleft_A \quad P\left(b + \frac{d}{2}\right) - H\cdot C = 0$ ⇒

$F\left(b + \frac{d}{2}\right) = NC$;

$\frac{F}{N} = \frac{C}{b + d/2}$

Max utbildad friktion:

$\frac{F}{N} = \mu_s$ ⇒ $\mu_s \geq \frac{C}{b+d/2} = \frac{0.15}{0.5+0.05} = 0.27$ ⇒

Ingen glidning kräver $\mu_s \geq 0.27$

---

4)

Hastighet: $\frac{dv}{dt} = a$; $v = at + v(0)$

Vändläge: $v = 0$ ⇒ $t = \frac{v(0)}{-a} = \frac{7}{2} = 3.5\,s$

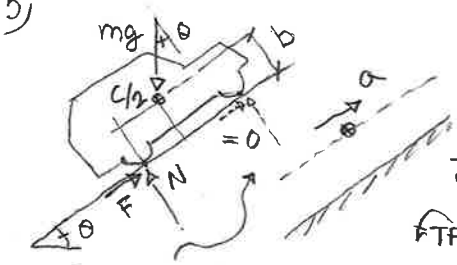
Sträcka: $\frac{ds}{dt} = v$; $s = \frac{at^2}{2} + v(0)t + s(0)$;

Alltså $\begin{cases} v(t) = -2t + 7 \quad (m/s) \\ s(t) = -t^2 + 7t + 3 \quad (m) \end{cases}$

Max s i vändläget: $s_{max} = s(t = 3.5\,s) = 15.25\,m$

---

5)



Hjulen lyfter

Translationsrörelse:

NII $(\nearrow) \quad F - mg\sin\theta = ma$

Jmv. $(\nwarrow) \quad N - mg\cos\theta = 0$

FTP $\quad F\cdot b - N\cdot\frac{C}{2} = 0$

5 forts.

$(\rightarrow) \Rightarrow F = m(g\sin\theta + a)$, $(\nwarrow) \Rightarrow N = mg\cos\theta$

$\Rightarrow \frac{F}{N} = \frac{a + g\sin\theta}{g\cos\theta}$ Men ~~TP~~ $\Rightarrow \frac{F}{N} = \frac{c}{2b}$

Dvs $\frac{a + g\sin\theta}{g\cos\theta} = \frac{c}{2b}$;

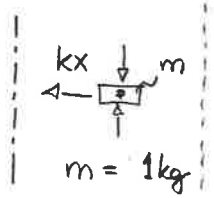
Anm. Det krävs väldigt hög friktion ($\mu > 1$) för att kunna lyfta hjulen.

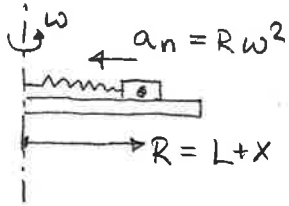
$a = \frac{c}{2b} \cdot g\cos\theta - g\sin\theta =$

$= 9.81 \cdot \left(\frac{2.2}{2 \cdot 0.8} \cdot \cos 40° - \sin 40°\right) = 4.0\ m/s^2$

---

6)





$\begin{cases} \omega = 4\ rad/s \\ L = 0.4m \end{cases}$

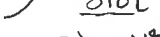
NII $(\leftarrow) \Rightarrow kx = m(L+x)\omega^2$;

$40 \cdot x = 1 \cdot (0.4 + x)\, 4^2$; $40x = 6.4 + 16x$;

$x = \frac{6.4}{24} = 0.27m$

---

7) Stöt : $(\rightarrow)$ $mv = mv_1'' + mv_2''$; $v_1'' + v_2'' = v$ ... (1)



$e = (v_2'' - v_1'')/v$; $-v_1'' + v_2'' = ev$ ... (2)

(1)+(2) $\Rightarrow 2v_2'' = (e+1)v$; $v_2'' = \frac{1+e}{2}v = 8\ m/s$

Energi :

①:

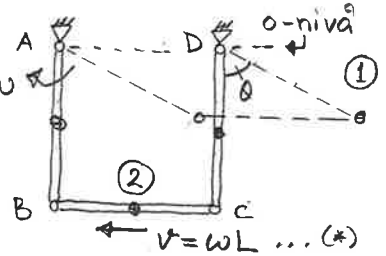
②:

$\frac{1}{2}mv_2''^2 = mgh$;

$h = \frac{(v_2'')^2}{2g} = \frac{8^2}{2 \cdot 9.81} = 3.3m$ (ober. av R)

---

8)



Stängerna (m, L) släpps från vila $\theta = 60°$

Translations rörelse för BC och rot. fix axel för AB och DC.

Hastigheten genom energiberäkning :

$E_1 = -mgL\cos\theta - mg\frac{L}{2}\cos\theta \cdot 2 =$

$= -mg\frac{L}{2} - mg\frac{L}{2} = -mgL$

$E_2 = \frac{1}{2}I_0\omega^2 \cdot 2 + \frac{1}{2}mv^2 - mg\frac{L}{2} \cdot 2 - mgL$

Tröghets moment $I_0 = \frac{mL^2}{3}$ samt

(*) $\Rightarrow v = \omega L$

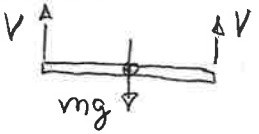
Dvs $E_2 = \frac{1}{2}\frac{1}{3}mL^2\omega^2 \cdot 2 + \frac{1}{2}m(\omega L)^2 - 2mgL$

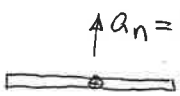
$E_1 = E_2$; $-mgL = \left(\frac{1}{3}mL^2 + \frac{1}{2}mL^2\right)\omega^2$;

$\omega^2 = g/\left(\frac{L}{3} + \frac{L}{2}\right) = \frac{6g}{5L} = \frac{6 \cdot 9.81}{5 \cdot 1} = 11.8$

$\omega = 3.43$ rad/s dvs $v = 3.43\ m/s$

Kraften :





(↑) $2V - mg = mL\omega^2$; $V = \frac{1}{2}m(g + L\omega^2)$;

$V = \frac{1}{2}m\left(g + \frac{6}{5}g\right) = \frac{mg}{2}\left(1 + \frac{6}{5}\right) = 1.1mg = 54N$

(Jmf. statiskt $V = \frac{mg}{2}$)